

# Service Learning: Taking Mathematics into the Real World

See "Sharing Teaching Ideas: When Will I Ever Use This Stuff, Anyway?" on page 798 for more information about service learning.



In recent years mathematics educators have expressed regret that classroom mathematics too often has little relationship to problem solving in the real world. Consider this indictment from the Mathematical Sciences Education Board of the National Research Council. "Students who progress through this curriculum develop a kind of mathematical myopia in which the goal is to solve artificial word problems rather than realistic world problems" (MSEB 1990, 4). The Board further insisted that the primary goal of instruction should require students "to use mathematical tools in contexts that mirror their use in actual situations" (MSEB 1990, 38). In a similar vein, educators are being urged to involve their students in service learning. Service learning can be used both as a tool for community service and as a means of taking school mathematics into the real world. This article introduces service learning, explores how it can be used in mathematics education, and relates the author's personal experiences in using service learning in his mathematics classes.

## INTRODUCTION TO SERVICE LEARNING

The idea for youth to spend time in community service has periodically arisen in American education. In the 1920s and 1930s, progressive educators championed the Kilpatrick "project method." The twofold purpose of the method was to promote learning outside of schools and to meet the real needs of the community. In the 1950s, Columbia University Teachers College sponsored the Citizenship Education Project. The community-service idea arose yet again in the 1970s, with the National Committee on Resources for Youth (Conrad and Hedin 1991). More recently, President Bush signed the National and Community Service Act of 1990, and President Clinton opened a summit for service in April 1997.

Service learning is becoming more important in American secondary and collegiate education, but a precise definition of what it entails is not easy to find. Kahne and Westheimer (1996, 593) suggested

this definition: "Service learning makes students active participants in service projects that aim to respond to the needs of the community while furthering the academic goals of students." This balance between community service and academic learning is not easy to attain.

From thirty-seven years of experience, Robert Sigmon clarified at least four different ways to view service learning. Sigmon used the term *service learning* to denote such practices as student involvement in building houses for Habitat for Humanity. Students perform a service and may even be required to examine their social values through reading or writing, but the direct connection between service and learning is largely left to the student to discover. Sigmon used *SERVICE-learning* to describe projects in which service is foremost and the learning that takes place is derived from the service experience. For activities that stress the use of service to augment what is learned in the classroom, Sigmon used the designation *service-LEARNING*. Finally, *SERVICE-LEARNING* represented a project in which the service component and the learning component were balanced and complementary (Sigmon 1995).

## MATHEMATICS AND SERVICE LEARNING

*Programs in elementary and secondary schools*

A survey of literature on service learning located the following examples that use mathematics to

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varying degrees. At the high school level, one popular type of service learning, which includes quantitative practices, is environmental monitoring. A program at Lincoln High School in Philadelphia resulted in establishing the Lincoln Environmental Laboratory, with more than \$2 million in donated equipment. The horticulture program at Lincoln High School involved students in designing parks, a project that required some use of geometrical areas and that involved financial considerations. Another program at Lincoln High School involved tax preparation for the elderly (Silcox 1991).

In an interesting program at Chestnut Middle School in Springfield, Massachusetts, students determined the optimum seating arrangements for a local theater (Anderson et al. 1991). Finally, several schools have programs in which more advanced students tutor less advanced students. Conrad and Hedin (1991) reported that such programs resulted in higher mathematics achievement scores for both the tutors and those being tutored.

Searches on the World Wide Web revealed two sites with databases on service-learning programs across the United States: Serve America and The National Service-Learning Cooperative Clearinghouse. The most common forms of service learning for mathematics were offering tutoring services for elementary students or lower-achieving peers and using mathematics to design gardens, trails, landscaping, and building projects for the community. Another frequently used idea was an environmental or recycling program in which mathematics is used in accounting. Other programs incorporated mathematics in service learning by operating a small business, shopping for senior citizens, conducting surveys among alumni, calculating growth rates in gardens, and reviewing statistics on violence.

### *Programs at Shorter College*

Shifting from a national survey to personal experiences, the author has been experimenting with service learning in both mathematics and education classes at Shorter College. Of interest here are three experiences involving introductory statistics classes. In the spring semester of 1996, the introductory statistics class prepared a booklet for United Way of Rome and Floyd County (Georgia).

When approached about the possibility of a service-learning project for the class, the local United Way director indicated that a booklet that had been used in fund-raising needed to be updated. The booklet, which used statistical data and graphs to introduce each agency that received United Way funding, was more than five years old. Because of a shortage of staff, United Way could not revise it. The class provided the personnel.

The project required three visits to each agency. After a class session during which students

received instructions, students visited their assigned agencies to compile data for the booklet. The students then transformed the raw data into bar graphs and pie charts. They presented other information in tables or charts. Since each agency was limited to one 8 1/2-by-5 1/2-inch page, the students decided how to convey the most information in the least amount of space. The students had to learn to use spreadsheets to generate these graphs. They presented a rough draft to the professor, the agency, and the United Way director. After making revisions, a third visit to the agency was needed to get the agency's signed approval. The local United Way published the final product, which is being used in its fund-raising efforts.

The learning goals for this project were—

- to give the students real experience in gathering, organizing, and presenting descriptive statistics;
- to serve the community;
- to reinforce and expand the students' use of computers from previous courses; and
- to connect statistics to the real world.

In an anonymous survey of students, 88 percent stated something positive that they learned from this experience. The most frequent response indicated that they learned how statistics related to real life (75 percent). Other students responded that they learned more about the United Way and its agencies, that they learned how to use computers to generate graphs and charts, that they discovered how frustrating it is to work with other people's schedules, and that they learned how to do research and organize data. More than 70 percent of the students thought that the project was worthwhile. The agencies responded favorably to the project. They gave the Shorter students extremely high marks in courtesy, responsibility, and providing a real service. Agency directors indicated that on the basis of this experience, they would strongly consider hiring Shorter graduates when positions were available. All indicated that they would like to be involved in future programs.

In 1997 the introductory statistics class was involved in two other service projects. Most of the students conducted a survey of volunteerism in Rome and Floyd County, Georgia. Each of the five teams used a different sampling technique, such as a random evening telephone sample, a random daytime telephone sample, a convenience sample in the downtown shopping district, a cluster sample of residents in a local neighborhood, and a convenience sample at a local church. In addition to learning about the local community, students later learned how the different samples resulted in different data.

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After conducting the surveys, the students entered the information into databases. The students used the databases to generate bar graphs and pie charts. In a third phase of the project, students used findings from their particular survey to apply hypothesis-testing procedures to questions they had about characteristics of the local community. By using a variety of sampling techniques, the opportunity arose to discuss the reliability of hypothesis testing with each type of sample. For instance, one might not expect to obtain reliable data for hypothesis testing by using a convenience sample. Finally, the students used statistical tests to compare the results of each sampling technique.

The original goal was to share the acquired information with local service agencies and the local media. When this article was written, that goal had not been accomplished. Sigmon would consider this project a "service-LEARNING" project.

A smaller group of students did a "SERVICE-LEARNING" project. Those students performed a statistical analysis of the work of the Community InfoLine (CIL), a local agency funded mostly by the United Way. The director of the CIL gave the students raw data concerning the types of calls, characteristics of the callers, outcomes of the calls, information on follow-up, and ways the callers had learned about the CIL. With the professor's guidance, the students decided on the appropriate types of graphs to illustrate the information for a report on the agency's work. The data were entered into spreadsheets, and students generated a variety of bar graphs, pie charts, and line graphs. They made overhead transparencies of those graphs for the CIL director to use in her presentations to the United Way's allocation committee. The graphs were also incorporated into a narrative report that was shared with the committee. After her presentation, the director stated that the committee was impressed with the report and overhead transparencies.

### INSTRUCTOR CONCERNS

Clearly, service learning has the potential to take mathematics into the real world. Teachers may wonder whether students should complete these projects during class time or out of class. In my experience, some class time was necessary to explain the projects and to help students organize their approach. Most of the work, however, was done outside of class, much in the same way as a term paper would be done for English class.

How much time do such projects require of the teacher? These projects do require that the teacher set up the project and oversee its completion. During the United Way booklet project, I made three trips to the local office. Each one took about an hour. The most time-intensive part of that project was editing the final draft, which took approximately

three or four hours of my time. I spent much less time with the Community InfoLine project.

Can these projects be repeated, or are they one-shot situations? The answer depends on the project. On the one hand, a project such as those in which students design parks or buildings would likely be a one-shot experience. On the other hand, I have used service learning for three years in my statistics classes. In 1998, several groups helped six different United Way agencies prepare for their allocations' presentations. Because these presentations must be made each year, each class can have a similar experience. Also, the United Way office recently requested that my class update the booklet that a class revised in 1996 and help with a survey of United Way givers in the ensuing year. Finally, with some more advance preparation, some agencies that offer after-school tutoring programs could make use of a statistical analysis of their programs' effectiveness.

To be sure, these projects did require time and planning on the part of the teacher, students, and the directors of the various agencies. Upper-level college students completed these projects, but Advanced Placement statistics students could easily do similar projects in high school. Also, an introductory statistics class tends to lend itself more easily to service-learning experiences than an algebra class would. With creativity and planning, mathematics educators can use service learning as a means of relating mathematics to the real world.

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The mentors' assessments were also supportive of our project. Their comments reflected a willingness to continue their association with the project. One mentor commented, "I think your project is right on target! Being a poor algebra student in high school/college, I saw little or no need how algebra would help me in life. [S]howing students the real needs, as in practical situations, not only clarifies but makes a dry learning process fun (good job!)."

## CHALLENGES

1. Our intermediate-algebra course is crammed with content that must be mastered for successful entry to the next level of mathematics. Every minute of class time counts. The class time needed to explain the service-learning project, to allow for group work, and to make presentations created an ongoing conflict with the time needed to deliver the course content. Tailoring the syllabus to meet the requirements of the course and the project was a challenge, but the opportunity to make mathematics come alive allowed us to face this challenge.
2. Working with the public schools involved issues of unobtrusiveness, scheduling, convenience, and competing projects. A typical teaching day anywhere is already very dense. Although the notion of serving the community by sharing with other schools was a lofty ideal, gaining entry into the schools was not easy. It took patience, perseverance, and a bit of a sales pitch.
3. When working in groups, some students resist being part of a team. This problem, of course, presents challenges to group members and to their teacher. In the future, group members may be asked to assess one another's contributions to the project as a significant part of the overall project grade.
4. Most presentations took a simplistic view of algebra. Students found an abundance of proportion problems and simple linear equations. Students took the position that "if it has an  $x$ , then it must be algebra."
5. As a result of the service-learning project, students had an opportunity to observe a variety of careers that ranged from the obvious, for example, a mathematics tutor, to the not so obvious, for example, an electrician. We suggest that teachers make a concentrated effort to challenge students to seek more unusual and interesting vocations and careers.

In light of these challenges, we would do the project again. It is well worth the effort to encourage students to dig deeper to uncover the many ways that mathematics is at work in the world and to learn why mastery of it greatly enriches all our lives.

To get more information about our project,

including topics, worksheets, and so forth, contact the authors via e-mail.

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**Serving the community by sharing with other schools was a lofty ideal**

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### SERVICE LEARNING RESOURCES ON THE INTERNET

- American Association of Community Colleges Service Learning.  
[www.aacc.nche.edu/initiatives/service/service.htm](http://www.aacc.nche.edu/initiatives/service/service.htm)  
 This site introduces the concept of service learning and provides examples.
- Big Dummy's Guide to Service-Learning.  
[www.fiu.edu/~time4chg/Library/bigdummy.html](http://www.fiu.edu/~time4chg/Library/bigdummy.html)  
 This site gives answers to twenty-seven questions on faculty, programmatic, student, administrative, and nonprofit issues.
- Learn and Serve America.  
[www.learnandserve.org/index.html](http://www.learnandserve.org/index.html).  
 This site gives information on the Learn and Serve America programs.
- National Service-Learning Cooperative Clearinghouse.  
[www.nicssl.coled.umn.edu/](http://www.nicssl.coled.umn.edu/)  
 This site includes databases of programs, organizations, people, events, and information resources on service learning.
- Service Learning Website at the University of Colorado.  
[csf.colorado.edu/sl/main.html](http://csf.colorado.edu/sl/main.html)  
 This site includes a wealth of information on service learning. Included are guides to programs, course lists, syllabi, links to other organizations on the Web, discussion groups, a calendar of conferences and events, and the *Service Learning Handbook* for the University of Colorado.